SECTION 16264

STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Installation of static uninterruptible power supplies.

B. Related Sections: The following sections contain requirements that relate to this section:
   1. Section 16050, Basic Materials and Methods.
   2. Section 16111, Conduit and Fittings.
   3. Section 16120, Building Wire and Cable, 600V and Below.
   4. Section 16160, Panelboards.
   5. Section 16196, Electrical Identification.
   6. Section 16215, Electrical Power Monitoring.
   7. Section 16450, Grounding.

1.3 DEFINITIONS

A. EMI: Electromagnetic Interference.

B. LCD: Liquid-Crystal Display.

C. LED: Light-Emitting Diode.

D. THD: Total Harmonic Distortion.

E. UPS: Uninterruptible Power Supply.

1.4 REFERENCES

A. Code of federal Regulations (CFR):
   1. 29 CFR 1910.7 1998, Occupational Safety and Health Standards.
   2. 47 CFR 15, Telecommunications Systems.

B. National Fire Protection Association (NFPA):
   1. NFPA 70, National Electrical Code. 1999.
   2. NFPA 75, Standard for Protection of Electronic Computer/Data Processing Equipment.

C. Underwriters' Laboratories, Inc. (Ul):
   1. Ul 1778, 1994, Uninterruptable Power Supply Equipment.
   2. UL 891, 1994, Dead Front Switchboards.
   3. UL 1561, 1994, Dry Type General Purpose and Power Transformers.

D. National electrical Manufacturers Association (NEMA):
   1. NEMA 250, 1991, Enclosures for Electrical Equipment.
   2. NEMA PB2, 1995, Dead Front Distribution Switchboards.

E. Institute of Electrical and Electronics Engineers (IEEE):
   1. IEEEc 62.41, 1991, Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits.

1.5 SUBMITTALS

A. Product Data: Include data on features, components, ratings, and performance for each uninterruptible power supply component indicated.

B. Shop Drawings: Detail assemblies of equipment indicating dimensions, weights, components, and location and identification of each field connection. Show access, workspace, and clearance requirements; details of control panels; and battery arrangement.
   1. Wiring Diagrams: Detail internal and interconnecting wiring; and power, signal, communications and control wiring. Differentiate between field-installed and factory-installed wiring and components.

C. Manufacturer Seismic Qualification Certification: Submit certification that UPS equipment will withstand seismic forces defined in general conditions. Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

F. Factory Test Reports: Comply with specified requirements.

G. Field Test Reports: Indicate test results compared with specified performance requirements, and provide justification and resolution of differences if values do not agree.

H. Maintenance Data: For UPS units to include in maintenance manuals specified in general conditions. Include the following:
   1. Lists of spare parts and replacement components recommended being stored at Project site for ready access.
   2. Detailed operating instructions covering operation under both normal and abnormal conditions.

I. Warranties: Special warranties as specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of UPS manufacturer for both installation and maintenance of units required for this Project.

B. Power Quality Consultant Qualifications: A registered professional electrical engineer or engineering technician, currently certified by the National Institute for Certification in Engineering Technologies, NICET level 4, minimum, experienced in functional performance

testing UPS installations and in performing power quality surveys similar to that required in Part 3 "Functional Performance Testing" Article.

C. Manufacturer Qualifications: A firm who maintains a service center capable of providing training, parts, and emergency maintenance and repairs for equipment at Project site with eight hours' maximum response time.

D. Testing Agency Qualifications: An independent testing agency with experience and capability to conduct testing indicated without delaying the Work, as documented according to OSHA criteria for accreditation of testing laboratories, 29 CFR 1910.7; or a full member company of the InterNational Electrical Testing Association.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

E. Source Limitations: Obtain the UPS and associated components specified in this Section from a single manufacturer with responsibility for entire UPS installation.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
   1. UPS Units: Listed and labeled under UL 1778.
   2. Mark UPS components as suitable for installation in computer rooms according to NFPA 75.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in fully enclosed vehicles after specified environmental conditions have been permanently established in spaces where equipment is to be placed.

B. Store equipment in spaces with environments controlled within manufacturers' ambient temperature and humidity tolerances for nonoperating equipment.

1.8 WARRANTY

A. Warranties, General: Special warranties specified in this Article shall not deprive Owner of other rights that Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Battery Warranties: Written warranty, signed by manufacturer and Installer agreeing to replace UPS system storage batteries that fail in materials or workmanship within specified warranty period.
   1. Warranted Cycle Life for Sealed Lead-Acid Batteries: Equal to or greater than that represented in manufacturer's published table, including figures corresponding to the following, based on annual average battery temperature of 77 deg F (25 deg C):
   2. Warranted Cycle Life for Premium Sealed Lead-Acid Batteries: Equal or greater than that represented in manufacturer's published table, including figures corresponding to the following, based on annual average battery temperature of 77 deg F (25 deg C):

Discharge Rate	Discharge Duration	Discharge End Voltage	Cycle Life
8 hours	8 hours	1.67	40 cycles
30 minutes	30 minutes	1.67	125 cycles
15 minutes	1 minute	1.67	750 cycles

C. Special UPS Warranties: Written warranties, signed by manufacturer and Installer agreeing to replace components that fail in materials or workmanship within special warranty period.
   1. Special Warranty Period: Three years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Construction Manager:
   1. Fuses: One for every 10 of each type and rating, but not less than 1 of each.
   2. Cabinet Ventilation Filters: One complete set.
   3. One spare circuit board for each critical circuit.

PART 2 - PRODUCTS

2.1 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Uninterruptible Power Supplies are included as part of the directed procurement program for this project. The Construction Manager is administering the program and equipment shall be purchased in accordance with program requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install system components on 4-inch- (100-mm-) high concrete bases. Cast-in-place concrete, reinforcing, and formwork are specified in Division 3.

B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

C. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams, unless otherwise indicated.

3.2 GROUNDING

A. Comply with Division 16 Section, "Grounding" for materials and installation requirements.

B. Separately Derived Systems: If not part of a listed power supply for a data-processing room, comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near isolation transformer.

3.3 IDENTIFICATION

A. Identify components and wiring according to Division 16, Electrical Identification:
   1. Identify each battery cell individually.

3.4 BATTERY EQUALIZATION

A. Equalize charging of battery cells according to manufacturer's written instructions. Record individual-cell voltages.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage the services of a factory-authorized service representative to supervise UPS installation, startup, and preliminary testing and adjustment and to participate in final tests, inspections, and adjustments.

B. Electrical Tests and Inspections: Perform tests and inspections according to manufacturer's written instructions and as listed below to demonstrate condition and performance of each component of the UPS:
   1. Inspect interiors of enclosures, including the following:
      a. Integrity of mechanical and electrical connections.
      b. Component type and labeling verification.
      c. Ratings of installed components.
   2. Test manual and automatic operational features and system protective and alarm functions.
   3. Test communication of status and alarms to remote monitoring equipment.

C. Electrical Tests and Inspections: Perform tests and inspections listed below by an independent testing agency meeting the qualifications specified in "Quality Assurance" Article according to manufacturer's written instructions and as listed below to demonstrate condition and performance of each UPS:
   1. Inspect interiors of enclosures, including the following:
      a. Integrity of mechanical and electrical connections.
      b. Component type and labeling verification.
      c. Ratings of installed components.
   2. Load the system using a variable-load bank to simulate kilovolt amperes, kilowatts, and power factor of loads for the unit's rating. Use instruments calibrated, within the previous six months according to NIST standards.
      a. Simulate malfunctions to verify protective device operation.
      b. Test duration of supply on emergency, low-battery voltage shutdown, and transfers and restoration due to normal source failure.
      c. Test harmonic content of input and output current less than 25, 50, and 100 percent of rated loads.
      d. Test output voltage under specified transient-load conditions.
      e. Test efficiency at 50, 75, and 100 percent rated loads.
      f. Test remote status and alarm panel functions.
      g. Test battery-monitoring system functions.

D. Seismic-restraint tests and inspections shall include the following:
   1. Inspect type, size, quantity, arrangement, and proper installation of mounting or anchorage devices.

E. Retest: Correct deficiencies and retest until specified requirements are met.

F. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Construction Manager specified maintenance personnel to adjust, operate, and maintain the UPS.
   1. Train Construction Manager specified maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.

2. Review data in maintenance manuals. Refer to General and Supplementary Conditions' section "Closeout Procedures."
3. Review data in maintenance manuals. Refer to General and Supplementary Conditions' section "Operation and Maintenance Data."
4. Schedule training with Construction Manager, with at least seven days' advance notice.

3.7 FUNCTIONAL PERFORMANCE TESTING

A. Monitoring and Testing Schedule: Perform monitoring and testing in a single 10-day period Schedule monitoring and testing activity with Construction Manager, with at least 14 days' advance notice.
   1. Schedule monitoring and testing after Substantial Completion, when UPS is supplying power to its intended load.

B. Monitoring and Testing Instruments: Three-phase, recording power monitors. Instruments shall provide continuous simultaneous monitoring of electrical parameters at input terminals of the UPS and at input terminals of a load served by the UPS. Instruments shall monitor, measure, and graph voltage current and frequency simultaneously and provide full-graphic recordings of the values of those parameters before and during power line disturbances that cause the values to deviate from normal beyond the adjustable threshold values. Instruments shall be capable of recording either on paper or on magnetic media and have a minimum accuracy of plus or minus 2 percent for electrical parameters. Parameters to be monitored include the following:
   1. Current: Each phase and neutral and grounding conductors.
   2. Voltage: Phase to phase, phase to neutral, phase to ground, and neutral to ground.
   3. Frequency transients.
   4. Voltage swells and sags.
   5. Voltage impulses, phase to phase, phase to neutral, phase to ground, and neutral to ground.
   6. High-frequency noise.
   7. Radio-frequency interference.
   8. THD of the above currents and voltages.
   9. Harmonic content of currents and voltages above.

C. Monitoring and Testing Procedure: As follows :
   1. Exploratory Period: For approximately the first two days make recordings at various circuit locations and with various parameter-threshold and sampling-interval settings. Make these preliminary measurements with the objective of identifying optimum UPS, power system, load, and instrumentation set-up conditions for subsequent test and monitoring operations.
   2. Remainder of Test Period: Perform continuous monitoring of at least two circuit locations selected on the basis of data obtained during exploratory period.
      a. Set thresholds and sampling intervals for recording data at values selected to optimize data on performance of the UPS with respect to values specified in Part 2 of this Section, and to highlight any need to adjust, repair, or modify the UPS or any distribution system or load component that may influence its performance or that may require better power quality.
      b. Perform load and UPS power source switching and operate the UPS on generator power during portions of the test period according to directions of Owner's Power Quality Consultant.
      c. Operate the UPS and UPS loads in each mode of operation permitted by UPS controls and by the power distribution system design.
      d. Create and simulate unusual operating conditions, including outages, voltage swells and sags, and voltage, current, and frequency transients using temporarily connected resistive/inductive load banks and a temporarily

connected portable generator set. Maintain normal operating loads in operation on system to maximum extent possible during tests.

e. Make adjustments and repairs to UPS, distribution, and load equipment to correct deficiencies disclosed by monitoring and testing and repeat appropriate monitoring and testing to verify success of corrective action.

D. Correlation with Specified UPS Monitoring Functions: Obtain printout recordings of built-in monitoring functions specified for UPS and UPS components in this Section that are simultaneous with those made with portable instruments in this Article.

1. Provide the temporary use of an appropriate personal computer and printer equipped with required connections and software for recording and printing if such units are not available on-site.
2. Correlate printouts with recordings for monitoring performed according to this Article, and resolve and report any anomalies in and discrepancies between the two sets of records.

E. Monitoring and Testing Assistance by Contractor: As follows:

1. Open UPS and electrical distribution and load equipment and wiring enclosures to make monitoring and testing points accessible for temporary monitoring probe and sensor placement and removal as requested.
2. Observe monitoring and testing operations and ensure UPS and distribution and load equipment warranties are not compromised.
3. Perform switching and control of various UPS units, electrical distribution systems, and load components as directed by Power Quality Consultant. The consultant shall design this portion of monitoring and testing operations to expose the UPS to various operating environments, conditions, and events while response is observed, electrical parameters are monitored, and system and equipment deficiencies are identified.
4. Make repairs and adjustments to the UPS and to electrical distribution system and load components, and retest and repeat monitoring as needed to verify validity of results and correction of deficiencies.
5. Engage the services of UPS manufacturer's factory-authorized service representative periodically through functional performance testing operations for repairs, adjustments, and consultations.

F. Documentation: Record test point and sensor locations, instrument settings, and circuit and load conditions for each monitoring summary and power disturbance recording. Correlate simultaneous recordings made on UPS input and load circuits.

G. Analysis of Recorded Data and Report: Review and analyze test observations and recorded data and submit a detailed written report. Include the following in report:

1. Description of corrective actions performed during monitoring and survey work and their results.
2. Recommendations for further action to provide optimum performance by the UPS and appropriate power quality for non-UPS loads. Include a statement of priority ranking and a cost estimate for each recommendation that involves system or equipment revisions.
3. Copies of monitoring summary graphics and graphics illustrating harmonic content of significant voltages and currents.
4. Copies of graphics of power disturbance recordings that illustrate findings, conclusions, and recommendations.
5. Recommendations for operating, adjusting, or revising UPS controls.
6. Recommendation for alterations to the UPS installation.
7. Recommendations for adjusting or revising generator-set or automatic transfer switch installations or their controls.
8. Recommendations for power distribution system revisions.

9. Recommendations for adjusting or revising electrical loads, or their connections or controls.

H. Interim and Final Reports: Provide an interim report at the end of each test period and a final comprehensive report at the end of the final test and analysis period.

END OF SECTION 16264